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Forest Health Protection

Pacific Southwest Region
Northeastern California Shared Service Area

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To: District Ranger, Mt. Hough Ranger District, Plumas National Forest

Subject: Post-fire bark beetle activity within the 2012 Chips Fire (FHP Report NE14-07)

At the request of Maurice Huynh, Silviculturist, Mt. Hough Ranger District, I visited the Chips Fire with district staff on October 17, 2014. The objective of this visit was to evaluate bark beetle activity in fire-injured trees as related to the *Marking guidelines for fire-injured trees in California* (Smith and Cluck 2011) and *Hazard Tree Guidelines For Forest Service Facilities and Roads in the Pacific Southwest Region* (Angwin et al 2012). Findings and recommendations were provided to the marking crew in the field. This report serves to document the high level of post-fire bark beetle activity observed within portions of the Chips Fire and discuss future considerations for land managers when selecting fire-injured tree evaluation criteria during drought conditions and high bark beetle population levels.

Key Findings

- High levels of bark beetle attacks were observed on fire-injured ponderosa pine, sugar pine, white fir and Douglas-fir.
- Attacked trees appeared to have sustained relatively low levels of crown kill but potentially moderate to high levels of cambium kill and root injury.
- Affected stands consisted of mostly larger diameter trees (>15" dbh) and were generally in an overstocked condition.
- Trees were previously evaluated after the fire in 2012 and 2013 using Region 5 Forest Health Protection (FHP) fire-injured tree and hazard tree guidelines but did not meet the selected criteria for removal.
- Extreme drought conditions and elevated levels of bark beetle activity throughout this region (both in burned and unburned areas) are both key factors in the high numbers of recently attacked trees.
- The Chips Fire was salvaged logged within one to two years post-fire, including areas that are currently experiencing additional bark beetle-related mortality.
- This additional mortality has resulted in the need for another roadside hazard mitigation project within the fire perimeter.

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Description of the project area

The 2012 Chips Fire burned 76,333 acres on the Lassen and Plumas National Forests as well as private timber land south of Lake Almanor and north of Highway 70 (T25/26/27N, R6/7/8E). The elevation ranges from 2,200 – 6,400 feet with annual precipitation between 30 and 45 inches. Forested areas are Sierra mixed conifer with white fir (*Abies concolor*), Douglas-fir (*Pseudotsuga menziesii*), Jeffrey pine (*Pinus jeffreyi*), ponderosa pine (*Pinus ponderosa*), lodgepole pine (*Pinus contorta var. murrayana*), sugar pine (*Pinus lambertiana*), red fir (*Abies magnifica*) and incense cedar (*Calocedrus decurrens*). Approximately 70% of the forested area burned at low severity (<25% basal area loss), 12% at moderate severity (25-75% basal area loss) and 18% at high severity (>75% basal area loss).

Summary of potential bark beetle activity described in 2013 Chips Fire report (NE13-02)

FHP aerial detection surveys mapped pre-fire bark beetle-caused mortality within and adjacent to the Chips Fire area in 2011 and 2012. Bark beetle activity was elevated for both years with mostly fir engraver beetle (*Scolytus ventralis*)-caused mortality of white fir mapped in 2011 and western pine beetle (*Dendroctonus brevicomis*)-caused mortality of ponderosa pine and mountain pine beetle (*Dendroctonus ponderosae*)-caused mortality of sugar pine mapped in 2012. Other mapped bark beetle-caused mortality in 2102 included mountain pine beetle-killed lodgepole pine and fir engraver-killed red fir. Most mapped mortality consisted of single trees and small groups of trees.

Bark beetle populations were elevated in the area prior to the fire so higher than normal activity was anticipated in fire-injured trees, especially if dry conditions continued into the next year. This prediction was not just limited to fire-injured trees as continued elevated bark beetle activity was also expected in surrounding areas due to overstocked stand conditions and drought.

Additional tree mortality from a combination of fire injuries and bark beetle attacks was expected over the next three to five years. The highest mortality levels were expected to occur in the moderate and high vegetation severity areas with scattered mortality in the low vegetation severity areas. Bark beetle activity in fire-injured trees was not predicted to result in a population buildup that would subsequently spread into adjacent unburned stands at a significant level.

The potential for elevated post-fire bark beetle activity in all tree species (except for incense cedar), the current drier than normal conditions leading to increased moisture stress and the overstocked condition of many of the low burn severity stands were included in a list of things to consider when choosing the probability of mortality from the fire-injured tree marking guidelines.

Current bark beetle activity

Most of the moderate to high severity burn areas of the Chips Fire were salvage logged on both public and private land within one year. Some areas were logged during the second post-fire year. The Plumas National Forest selected a probability of mortality of 0.7 (0.9 for trees >40” dbh), without cambium sampling or an assessment of red turpentine beetle activity for pines, to mark fire-injured trees. Low severity areas were generally not salvaged logged except for portions that

were adjacent to roads. All bark beetle activity observed during this site visit was occurring in stands that were previously marked and harvested in 2012 and 2013.

Most areas observed during this site visit were mapped as low vegetation burn severity. These types of stands typically lost <25% of existing basal area during the fire. This assessment occurs immediately after the fire and does not capture delayed post-fire mortality due to fire injury and/or bark and woodboring beetle activity. Low and especially moderately burned areas are typically where post-fire bark beetle activity can be greatest. These areas can contain large numbers of moderately injured trees; trees with enough crown scorch and cambium injury to compromise their defense systems but not kill them outright. These trees can provide ideal habitat for bark beetles, especially if cambium injuries are concentrated on the lower bole or at the root collar. Most fire-killed trees found in high severity areas are not suitable habitat for successful bark beetle reproduction and are more often colonized by woodboring beetles.

Bark beetles and attacked host trees included western pine beetle (*Dendroctonus brevicomis*) in ponderosa pine, fir engraver beetle (*Scolytus ventralis*) in white fir, mountain pine beetle (*Dendroctonus ponderosae*) in sugar pine and Douglas-fir beetle (*Dendroctonus pseudotsugae*) in Douglas-fir. All attacked hosts, except for one small unburned pocket of white fir, had sustained some level of fire-injury which consisted of low to moderate crown kill and potentially moderate to high levels of cambium and root injury as indicated by extensive bole charring and complete consumption of all duff and litter and most course woody debris within the root zone.

Recently faded sugar pines were observed at elevated levels scattered throughout the burned area, especially larger diameter trees (>30”dbh). Closer inspection revealed mass attacks by mountain pine beetles and red turpentine beetles. Most of these recent faders sustained low levels of crown kill but high levels of cambium kill as many trees appeared to be essentially heat girdled at the root collar.

Low severity areas southeast of the Butt Valley Reservoir dam were particularly hard hit by western pine beetle and fir engraver beetle with many trees mass attacked during the summer of 2014. Attacked ponderosa pine in this area included faded trees likely attacked in June and green infested trees attacked sometime in the late summer and fall. In the fall of 2014, 1,570 green infested conifers were marked for removal next to roads in low to moderate burn severity areas. This number averaged out to approximately four green infested trees per acre within treatment units.

Fire-marking guideline considerations for drought and high bark beetle populations

The marking guidelines developed for the Chip Fire salvage and hazard tree abatement projects were based on *Marking guidelines for fire-injured trees in California* (Smith and Cluck 2011) and *Hazard Tree Guidelines For Forest Service Facilities and Roads in the Pacific Southwest Region* (Angwin et al 2012). The probability of mortality (Pm) selected was 0.7 for salvage and roadside hazard units (0.9 for trees >40” dbh). In roadside units, trees were also evaluated for structural defects and marked if they met high failure potential thresholds. Cambium sampling was not conducted due to time constraints and the additional work load relative to the small increase in

guideline accuracy that this variable provides. Red turpentine beetle attacks were not assessed due to the timing of timber marking occurring before the first post-fire beetle flight.

A Pm of 0.7 is a relatively conservative guideline in that a land manager can be fairly certain that a tree marked at this level is likely to die within the next 5 years. As a result, many trees that have a Pm of 0.1 to 0.6 will be left on the landscape and could ultimately die whether it is from fire-injury alone or a combination of fire-injury and bark beetle attack. Some land managers have had the ability to keep removing these trees as they die and have successfully met their post-fire management objectives. Other land managers have not had this ability for various reasons and have ended up with an excessive number of dead trees on the landscape after their salvage harvests at the Pm=0.7 were completed.

Another aspect of how well a Pm=0.7 can met post-fire management objectives is simply the number of fire-injured trees that remain that are close to a Pm=0.7. Some fires have burned at mostly high severity, killing trees immediately, with very few low and moderate severity acres containing fire-injured trees that initially survived the fire but have a higher probability of delayed mortality (e.g. a Pm=0.5 or greater). Other fires, such as the Chips Fire, have resulted in a large number of acres of low to moderate severity that contain high numbers of fire-injured trees that have a higher probability of mortality. Drought and bark beetles can increase the risk of mortality for these types of trees even more. Fire-injured trees are stressed trees and the available soil moisture (pre- and post-fire) as well as bark beetle population levels can play a significant role in their fate.

The current drought severity is unprecedented in many areas of California. In the most severely affected areas, bark beetles are causing high levels of tree mortality in nearly all conifer species. As a result, fire-injured trees located in recent wildfire areas as well as those resulting from fires in the coming year are at a higher risk of mortality than what would be expected under more normal precipitation conditions and bark beetle population levels. Land managers may want to consider revisiting previously salvaged wildfire areas to capture additional mortality if leaving it is likely to result in negative impacts to management objectives. When fire salvage projects are being planned for 2014 wildfires or for any 2015 wildfires, land managers should considered selecting a lower probability of mortality threshold that will compensate for the potential increase in fire-injured tree mortality or plan to harvest this additional delayed mortality as it occurs over the next few years.

The level of mountain pine beetle-caused mortality of sugar pine has also increased across the state during the current drought and land managers should expect to see high levels of mountain pine beetle activity in fire-injured sugar pine over the next few years. To help capture some of this mortality during fire salvage projects, land managers should consider utilizing the cambium kill criteria. High levels of cambium kill have been observed by FHP on larger diameter sugar pine in most wildfire areas over the past 15 years and trees that have extensive cambial injury are highly attractive to mountain pine beetles, even at lower levels of crown kill. Sugar pine can generally sustain higher levels of cambium kill than other tree species but can be particularly vulnerable to mountain pine beetles at higher damage thresholds. Hood et al (2010) found that when holding crown injury constant, sugar pine mortality increased only slightly until all cambium quadrants sampled were dead (CKR = 4), which follows past findings that sugar pine is capable of withstanding more extensive cambial injury than other California conifers (Wagener 1961). Hood

et al (2010) also observed that mountain pine beetles attacked 81% of the subset of sugar pines that subsequently died on the Power Fire (170 of 210 assessed trees). The Region 5 FHP fire-injured tree marking guidelines for sugar pine highlight how a high level of cambium injury affects sugar pine survival. These guidelines show that with up to three dead cambium samples (CKR=3) the crown kill criteria for sugar pine needs to be adjusted up 5% for a given probability of mortality. That means a tree with that level of cambium injury would require 5% more crown injury in order to me marked for removal. However, when a tree has four dead samples (CKR=4), the crown criteria needs to be adjusted down by 20%.

If you have any questions regarding this report and/or need additional information please contact Danny Cluck at 530-252-6431.

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